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160CT03 E884862-1 D02718
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1. Your reference — P11384GB/SPC/TC

2. Patent application number *(The Patent Office will fill this part in)* — 0324164.3 — 15 OCT 2003

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

Tellermate Plc.
Melrose Hall
St Mellons
Cardiff, South Wales CF3 0YZ
United Kingdom

8690240001

Patents ADP number *(if you know it)*

If the applicant is a corporate body, give the country/state of its incorporation — England and Wales

4. Title of the invention — IMPROVEMENTS IN CASH COUNTING

5. Name of your agent *(if you have one)* — David Keltie Associates

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

Fleet Place House
2 Fleet Place
London EC4M 7ET
United Kingdom

Patents ADP number *(if you know it)* — 04014502006 ✓

6. Priority: Complete this section if you are declaring priority from one or more earlier patent applications, filed in the last 12 months.

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

7. Divisionals, etc: Complete this section only if this application is a divisional application or resulted from an entitlement dispute (see note f)

Number of earlier UK application	Date of filing *(day / month / year)*

8. Is a Patents Form 7/77 (Statement of inventorship and of right to grant of a patent) required in support of this request?

Answer YES if:

a) any applicant named in part 3 is not an inventor, or
b) there is an inventor who is not named as an applicant, or
c) any named applicant is a corporate body.

Otherwise answer NO (See note d) — YES

Patents Form 1/77

9. Accompanying documents: A patent application must include a description of the invention. Not counting duplicates, please enter the number of pages of each item accompanying this form:

Continuation sheets of this form	
Description	10
Claim(s)	4
Abstract	1
Drawing(s)	2 + 2

10. If you are also filing any of the following, state how many against each item.

Priority documents	
Translations of priority documents	
Statement of inventorship and right to grant of a patent (Patents Form 7/77)	
Request for a preliminary examination and search (Patents Form 9/77)	ONE
Request for a substantive examination (Patents Form 10/77)	
Any other documents (please specify)	

11. I/We request the grant of a patent on the basis of this application.

Signature(s) David Keltie Associates David Keltie Associates Date 15 October 2003

12. Name, daytime telephone number and e-mail address, if any, of person to contact in the United Kingdom Ted Chwu 020 7329 8888

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Improvements in cash counting

This invention concerns improvements in cash counting, especially to the accuracy of cash counting machines that employ weighing techniques in determining cash values.

In retail sectors it is a longstanding problem that the value of cash held within cash registers is not immediately obvious and determining this value accurately requires a time-consuming manual count operation. The value of cash held within cash registers is important to know for management purposes, for example, to determine when a cash drawer is full, or nearly full, and an amount of cash (known as a float) needs to be removed from that drawer. This action is commonly referred to as 'skimming' or 'lifting' cash from a cash drawer. Cash values are also needed to determine cash levels within a cash register drawer during the day so that cashflow information may be obtained and fraudulent practices may be spotted. In all cases, it is desirable that accurate cash value data is obtained frequently throughout the working day or shift, that this is done with as little intrusion as possible to the operation of the cash register and that as little operator intervention is required as possible.

An example of an 'intelligent' cash register is disclosed in European patent application EP 0724242 to Tellermate Plc., which describes a cash register comprising weighing means arranged to take weight readings from the cash compartments of the cash register. The weight readings of each compartment may then be converted to a cash value by a processing unit so that the total cash value contained in the register may be obtained without manual intervention.

It will be appreciated that the term cash used herewith does not merely refer to banknotes and coins but also to any type of accepted tender or cash item, for example promissory notes, vouchers, tokens and the like. For ease of reference, the foregoing items based upon absorbent substrates like paper or

card, shall be referred to simply as 'banknotes', and the remainder shall be referred to simply as 'coins' in the rest of this specification.

With intelligent cash registers and all cash counting machines employing weight techniques, a fundamental principle to their accurate operation lies in their reliance upon a recognised standard weight for each type of banknote or coin being weighed. This standard weight is usually determined under normal ambient conditions and kept in a memory store for subsequent use during a count procedure.

It is also known that it is desirable to adjust, or re-calibrate, the standard weight for any type of banknote due to the varying conditions of banknotes encountered during trade. For example, frayed and torn banknotes are frequently tendered and such 'distressed' banknotes may differ appreciably from the standard weight. To provide for this, cash counting machines employing weighing techniques are able to re-calibrate upon sensing a trigger action, typically the initiation of a new transaction which will require a new cash count after the transaction finishes. For avoidance of doubt, the term "transaction" may comprise the following sample actions: a normal sale transaction, a no-sale drawer open action, a shift change involving change of staff, a management report request or other similar cashier or Point of Sale terminal related activity. Known counting machines only perform re-calibration actions when associated with a new transaction.

A typical re-calibration method employed incorporates first evaluating the Total Number of a type of banknote in a group, found by dividing the total weight of a group of that type of banknote by the standard weight of that type of banknote. If the resultant value is an exact whole number, there is no need to carry out the remaining steps of the re-calibration action. However, as the

$$\left(\frac{\text{Mantissa}}{\text{Total Number}}\right)\times\theta$$

Wherein θ is a calibration adjustment speed factor, and the result of the above calculation is applied to the standard weight to form the new updated and re-calibrated standard weight by the formula:

$$\textit{New Standard Weight} = \textit{Old Standard Weight} + \left(\frac{\text{Mantissa}}{\text{Total Number}}\right)\times\theta$$

It is noted in the above that the Mantissa may be a negative value.

The calibration adjustment speed factor θ represents the interval between re-calibration actions. If the re-calibration interval is too short, erroneous operation (such as the placement of a heavy coin into a banknote compartment by mistake) will severely affect the next re-calibration before the mistake is spotted and corrected. Conversely, if the re-calibration interval is too long, too much time may have elapsed since the last re-calibration and the most recent cash value results may have been calculated erroneously. The range of appropriate values for θ are determined by experimental analysis, and it is usually set at the lowest possible value consistent with adequate responsiveness, i.e. a suitably long time span between re-calibration trigger actions.

Table 1 shows how in the course of a typical day, the standard weight (in the form of a normalised calibration value) tracks to a more accurate true value as more and more items are counted, and more re-calibrations are carried out. In this case, the standard weight of a banknote was initially assumed to be 1 gram but calibration value tracks to the true average weight of 1.02 grams.

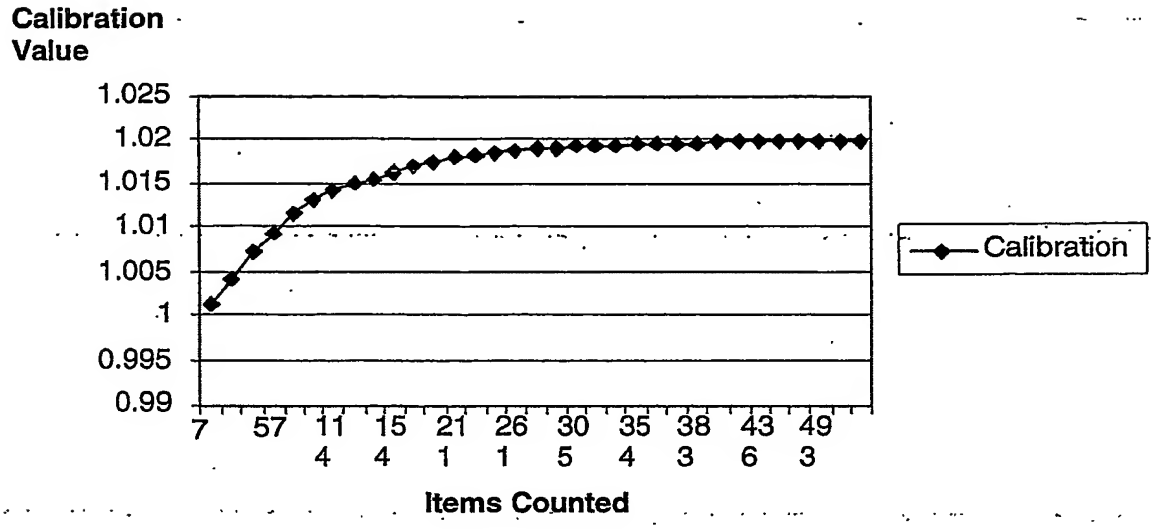

Table 1

An acknowledged problem in the context of weighing counting machines or intelligent cash registers has been the effect on accurate counting due to changing ambient conditions, especially humidity. It has been found that even slight changes in humidity have a profound effect, over time, on the weight of individual banknotes. Climatic factors, for example the starting of indoor air-conditioning systems, heating systems or the occurrence of a rainstorm in an outdoor retail environment, can easily lead to significant changes in the standard weight of banknotes in the order of, for example, around ± 3%. These changes may occur with particular suddenness when banknotes are transported from one environment to another, for example from a dry vehicle into a humid night-club, from a humid outdoor environment into an air-conditioned interior of a building, or even when a banknote is taken out a wallet that has been kept about a person. If this weight differential is

banknotes and coins to be wet or at least moist upon insertion into a cash drawer after a transaction. The subsequent period spent in the relatively hot confines of an electronic cash register drawer may dry out the banknotes, coins or the cash compartment itself, to the extent that subsequent cash value readings will be erroneous unless the standard weight is adjusted accordingly.

In known counting machines utilising weighing techniques, it is common for a simple rounding procedure to be used to round either up or down to the nearest whole banknote or coin. Accordingly, with a 2% weight differential between actual and standard weights, as little as 26 banknotes or coins will be enough to register a miscount by one whole banknote or coin using this simple and prevalent rounding procedure.

It is helpful here to introduce the term of a specific weight for a type of cash banknote or coin – this is simply the updated and re-calibrated standard weight of that type of cash at any time. This value can be determined through the procedure described above, or it may be determined through a simple method such as dividing the total weight of a plurality of the same type of banknotes by the number of banknotes present, determined by counting them. The methods of obtaining instantaneous specific weights with which this invention is compatible are not limited to those described in this specification and other methods may be well known in the art. For example, other methods of counting which involve transient 'cash-on, cash-off' actions are equally suitable. Indeed, the invention is insensitive to the procedure chosen to determine the new specific weight. Henceforth, the term "standard weight" will describe the last-determined weight value assumed from the last calibration, and the term "specific weight" will be used to describe the new instantaneous value of the specific weight found upon re-calibration.

The novel problem described above has not been addressed in known counting machines, and known counting machines are inadequate for this purpose, as they are designed to provide for banknotes and coins where different weights do not change materially over time spent being measured. For example, a banknote that is dirty or has a portion missing will differ in

weight from a pristine banknote but that difference will usually remain constant while the banknote is held in a till. Were re-calibration to take place, the difference between specific and standard weights of a type of cash caused by dirt or material defect does not change over the timeframe a banknote or coin is likely to spend in a cash register drawer, whereas climatic change does have the ability to affect the specific weight of the banknotes and coins within the drawer in the same timeframe, thus affecting counting accuracy if not taken into account.

It is with a view to solving these problems that the following is presented: a method of counting cash using weighing means wherein re-calibration of the specific weight of any cash type to be counted is initiated independent of any recorded transaction.

The invention also comprises weighing apparatus for counting cash wherein calibration of the specific weight of any cash type to be counted is initiated independent of any recorded transaction.

Further optional and preferred features are described in the appended dependent claims.

In order that the invention may be more readily understood, some embodiments in accordance therewith will now be described, by way of example, with reference to the accompanying drawings in which Figure 1 exemplifies a typical hardware system for implementing the method of the invention, and Figure 2 shows a functional block diagram of the method of the invention.

In Figure 1, there is provided weighing means 2 which may comprise the cash

store 6 and the processing unit 4 may read and write data to/from the data store 6. A video display unit 8, or some other means of alerting an operator or linked master control unit (not shown) to an erroneous situation, is optionally connected to the processing unit 4. For example, the processing unit 4 may, instead of being a stand-alone unit, be connected as part of a larger network (not shown in Figure 1) and receive and transmit data to a network controller (also not shown).

In use, to determine the value or number of a plurality of cash items placed on the weighing means 2, the weight reading output from the weighing means 2 is fed into the processing unit 4 which determines the cash value by processing the weight reading output with a stored value of the standard weight retrieved from the data store 6. If, at any point, a re-calibration of the standard weight is performed thereby generating a new specific weight as defined previously, the specific weight can be written to the data store 6 so that it overwrites the previous standard weight. The specific weight thus recorded becomes the new standard weight when a further re-calibration exercise generates a new specific weight.

Optionally, all the weight readings may be kept on the data store for retrieval at the end of the day or working shift, together with timestamps relating to the recordal of each item. This data may provide a pattern for standard weight deviation against time from which a look-up table of likely standard weights to be expected at given times of the business day or shift may be produced. As an example, the opening hours of a drinking establishment may serve as a template for standard weight deviation during the day and a template can be derived form it of when to perform autonomous re-calibrations irrespective of transaction activity.

Turning to Figure 2, this shows the method of the invention implemented by the apparatus shown in Figure 1. Starting at 1, an intelligent cash register drawer having associated weighing means 2 (shown in Figure 1) is in an idle state and an idle timer is running under control of the processing unit 4 of Figure 1. Although not shown in Figure 2, the intelligent cash register will have

a predetermined value for the standard weights of each cash type it is used with, which values are stored in the data store 6 of Figure 1. The predetermined values may be the official weights accepted as standard values for those cash types, e.g. published by the banknote printer or national banking authorities, or they may be derived from previous re-calibrations.

The timer value increments at 3 and a check state is entered at 5 wherein a check is carried out to determine whether a transaction request has been received by the cash register, and hence whether a change in cash value is likely to have occurred. Should the answer to check state 5 be positive, the new value of cash in the cash register drawer is counted at 7 and a running average and re-calibration to determine specific weights is carried out at 9 to be used in further cash value counts. The idle timer value is then cleared at 11 and the process reverts to 3 whereupon the idle timer value increments once again while awaiting a transaction request as before.

Should the check state at 5 produce a negative answer indicating no transaction has occurred, a further check state 13 is entered to check whether a predetermined limit for the idle timer value has been reached. Should check 13 be negative, the process reverts back to 3 and the idle timer value increments once again.

Should the check state at 13 produce a positive answer, indicating that no transaction has been made but that the predetermined value for the idle timer has been reached (i.e. a timeout), a forced drawer count is undertaken next at 15 using standard counting techniques and an update, similar to step 7, is next performed at 17 to provide a running average and re-calibration to generate new specific weights. The last step at 19 is to clear the idle timer value and restart the process from 3 wherein the idle timer value increments once.

ensures that the specific weights are determined by re-calibration, and/or the cash counted, even if the intelligent cash register remains unused. The period chosen between forced re-calibrations can be user defined, or it can be set according to external factors such as a detected change in ambient climatic conditions such as temperature, humidity (whether such change is detected having actually occurred or is expected from past experience to occur), a manually operated button or even a randomly generated time period.

It is further envisaged that should a change in ambient climatic conditions be detected, there should be a threshold level of change below which re-calibration is not initiated. A further optional feature would be to vary the time between successive re-calibrations depending upon the detected difference in climatic conditions since the last re-calibration – it is likely that in very humid or hot conditions re-calibrations will be preferably carried out with less time elapsed in-between successive re-calibrations.

In the case of re-calibration in response to detected or expected changes in ambient conditions, the threshold values for triggering re-calibration may be determined from experimental analysis on sample banknotes, coins and cash register drawer trays.

It is envisaged that the intelligent cash drawer, when used as part of a network of cash drawers connected to a central controller, could initiate a re-calibration upon receipt of a suitable signal sent via the network.

A discrimination feature may be provided with the above method whereby if a re-calibration does not result in a significantly different specific weight compared to standard weight, the full re-calibration process including storage of new specific weights may be aborted to save time.

It is further envisaged that the intelligent cash register drawer may continuously monitor the weight of the cash present and continuously calculate the variance between standard and specific weights, performing

successive re-calibrations autonomously, preferably according to predefined variance margins.

It should also be noted that whilst the above process is exemplified in the context of a cash register drawer, the method of the invention is equally applicable to all cash counting machines using weighing techniques, covered or not, indoor or not.

Claims

1. A method of counting cash comprising periodic calibration that involves retrieving a standard weight for a cash item, weighing one or more of said cash items to determine a specific weight for said cash item and storing the specific weight for use as a standard weight in a re-calibration, wherein said re-calibration is initiated autonomously.

2. The method of Claim 1 wherein re-calibration is initiated autonomously unless previously initiated by input of an external trigger.

3. The method of Claim 2 wherein the external trigger is detection of a transaction.

4. The method of Claim 3 wherein a transaction comprises a sale action, a no-sale action, a shift change involving change of staff, a management report request or other cashier or Point of Sale terminal related activity.

5. The method of any preceding claim wherein autonomous initiation of re-calibration takes place upon expiry of a time period since last calibration or re-calibration.

6. The method of any preceding claim wherein autonomous initiation of re-calibration takes place according to a predetermined schedule.

7. The method of Claim 6 wherein the predetermined schedule comprises fixed intervals between autonomous re-calibration initiations.

8. The method of Claim 6 wherein the predetermined schedule comprises regular intervals between autonomous re-calibration initiations.

9. The method of Claim 6 wherein the predetermined schedule comprises variable intervals between autonomous re-calibration initiations.

10. The method of Claim 9 wherein the intervals vary in response to the difference between standard and specific weights.

11. The method of Claim 9 wherein the intervals vary in response to climatic conditions.

12. The method of any preceding claim wherein autonomous initiation of re-calibration takes place upon expiry of a random time period since last calibration or re-calibration.

13. The method of any preceding claim wherein autonomous initiation is effected by sensing a change in climatic conditions.

14. The method of Claim 13 or Claim 14 wherein autonomous initiation is effected by sensing a climatic change in excess of a pre-determined threshold.

15. The method of Claim 14 wherein autonomous initiation is effected by sensing a change in temperature and/or humidity.

16. Apparatus for counting cash comprising:

weighing means for weighing one or more cash items;

data storage means for storing weight data generated by the weighing means; and

processing means for retrieving from and sending to the data storage means a standard weight and a specific weight for a cash item, and for performing re-calibration based upon a comparison of the standard and specific weights;

wherein said apparatus is arranged to initiate re-calibration

18. The apparatus according to Claim 16 or Claim 17 arranged so that re-calibration is initiated autonomously unless previously initiated by input of an external trigger.

19. The apparatus according to Claim 18 adapted to respond to an external trigger comprising of detection of a transaction.

20. The apparatus according to Claim 19 wherein the external trigger detected comprises a sale action, a no-sale action, a shift change involving change of staff, a management report request or other cashier or Point of Sale terminal related activity.

21. The apparatus according to Claim 16 or any dependent claim further adapted to initiate autonomous re-calibration upon expiry of a time period since the last calibration or re-calibration.

22. The apparatus according to Claim 16 or any dependent claim further adapted to initiate autonomous re-calibration according to a pre-determined schedule.

23. The apparatus according to Claim 22 wherein the predetermined schedule comprises fixed intervals between autonomous re-calibrations.

24. The apparatus according to Claim 22 wherein the predetermined schedule comprises regular intervals between autonomous re-calibrations.

25. The apparatus according to Claim 22 wherein the predetermined schedule comprises variable intervals between autonomous re-calibrations.

26. The apparatus according to Claim 25 wherein the intervals vary in response to the difference between standard and specific weights.

27. The apparatus of Claim 25 wherein the intervals vary in response to climatic conditions.

28. The apparatus of Claim 16 or any dependent claim further adapted to initiate autonomous re-calibration upon expiry of a random time period since last calibration or re-calibration.

29. The apparatus of Claim 16 or any dependent claim further adapted to initiate autonomous re-calibration upon sensing a change in climatic conditions.

30. The apparatus of Claim 29 further adapted to initiate autonomous re-calibration upon sensing a climatic change in excess of a predetermined threshold.

31. The apparatus of Claim 29 or Claim 30 further adapted to initiate autonomous re-calibration upon sensing a change in temperature and/or humidity.

Abstract

A method of counting cash comprising periodic calibration that involves retrieving a standard weight for a cash item, weighing one or more of said cash items to determine a specific weight for said cash item and storing the specific weight for use as a standard weight in a re-calibration, wherein said re-calibration is initiated autonomously.

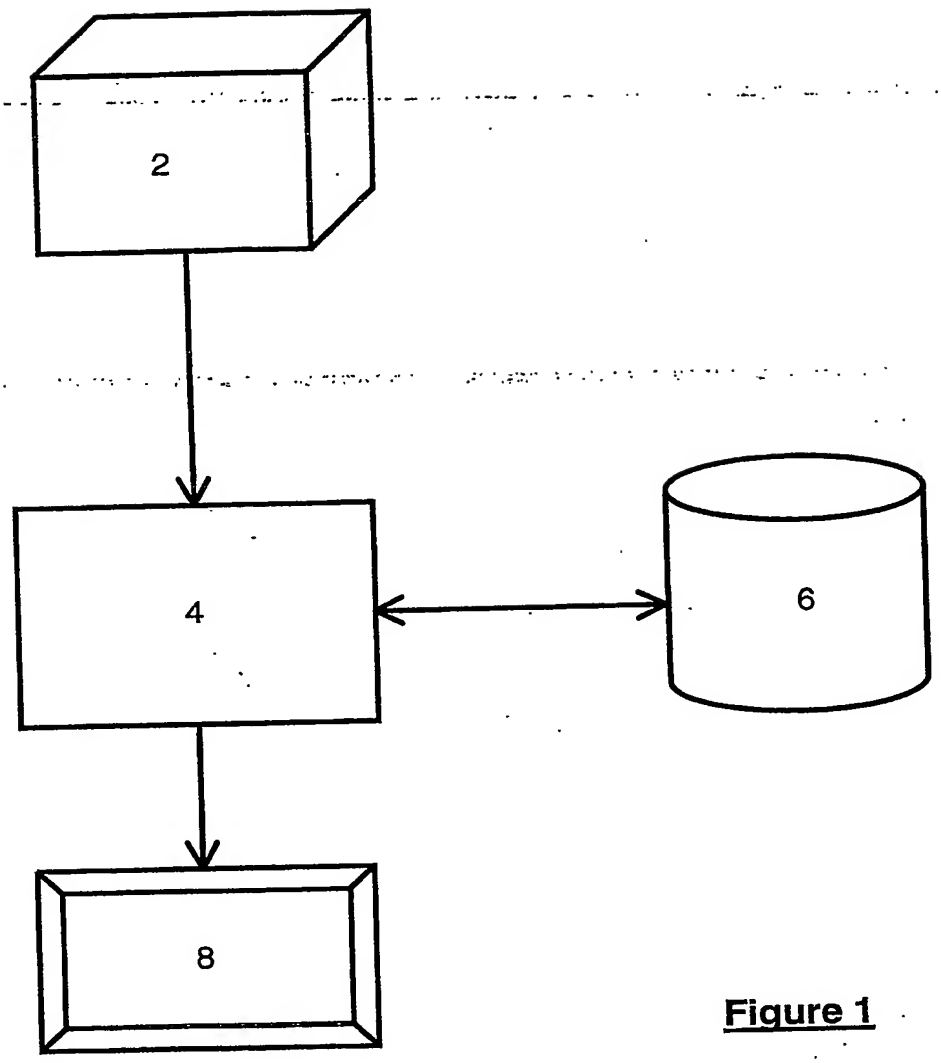

Figure 1

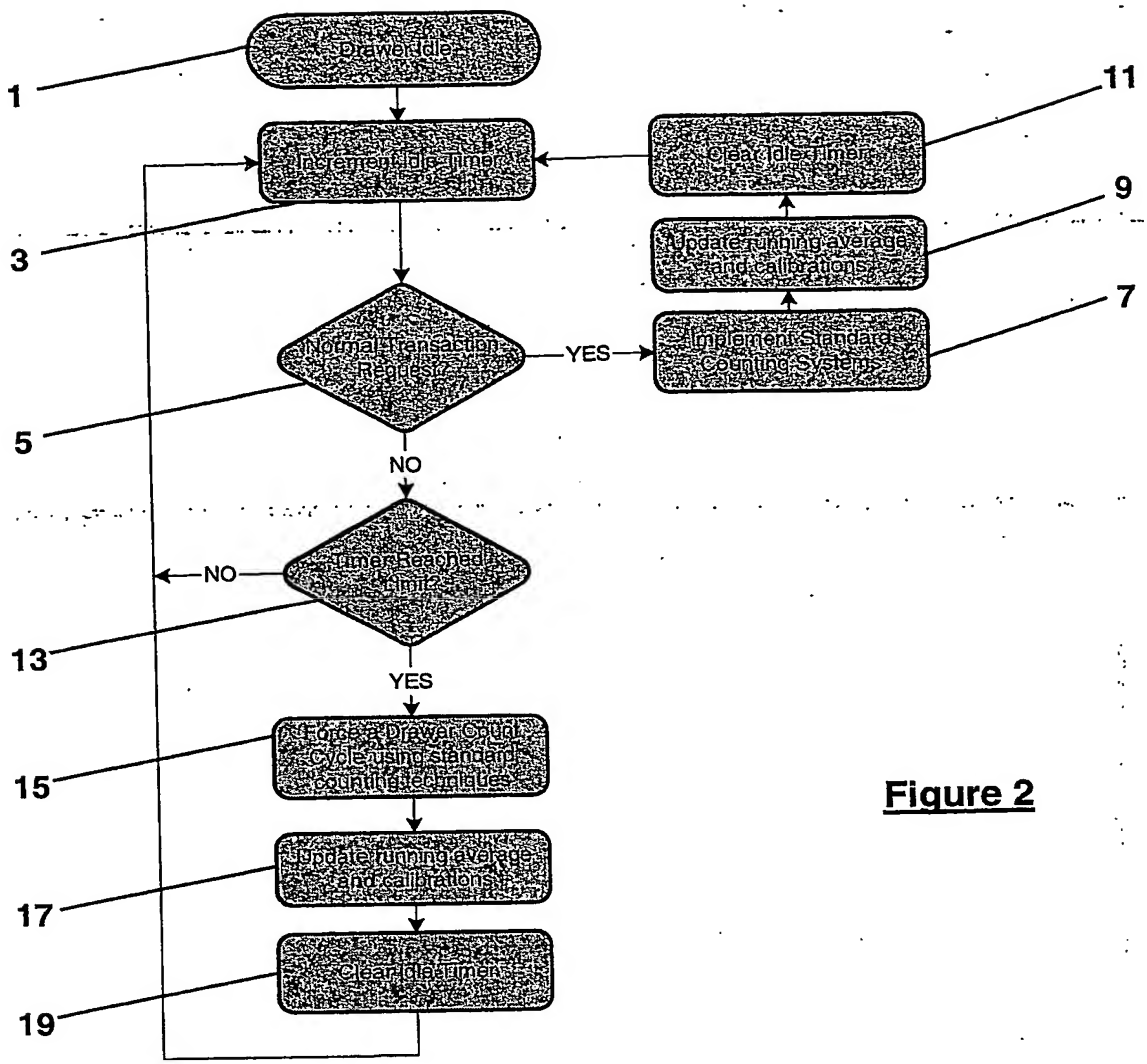
Drawer Idle
Increment Idle Timer
Normal Transaction Request?
YES
Implement Standard Counting System
Update running average and calibrations
Clear Idle Timer
NO
Timer Reached Limit?
NO
YES
Force a Drawer Count Cycle using Standard counting techniques
Update running average and calibrations
Clear Idle Timer
1
3
5
7
9
11
13
15
17
19

Figure 2